

Claims

[c1] What is claimed is:

1. A space transformer comprising:

a ground conductor;

a power conductor; and

one or more decoupling capacitors physically located between said ground conductor and said power conductor and electrically connected between a bottom surface of said ground conductor and a top surface of said power conductor.

[c2] 2. The space transformer of claim 1, further including:

one or more ground pins fixed to and extending from said ground conductor to a top surface of said space transformer;

one or more power pins fixed to and extending from said power conductor to said top surface of said space transformer; and

one or more signal wires extending from a bottom surface of said space transformer to said top surface of said space transformer.

[c3] 3. The space transformer of claim 2, wherein:

said ground conductor is located between said top surface of said space transformer and said power conductor;

said power conductor is located between said ground conductor and said bottom surface of said space transformer;

said one or more power pins pass through said ground conductor without electrically contacting said ground conductor; and

said one or more signal wires pass through both said power and said ground conductors without electrically contacting either of said power or

said ground conductors.

- [c4] 4. The space transformer of claim 2, wherein the length of an electrical path between said decoupling capacitors and said one or more ground pins and said one or more power pins at said top surface of said space transformer is between 5 to 25 millimeters.
- [c5] 5. The space transformer of claim 2, wherein the length of an electrical path between tips of said one or more ground pins and said one or more power pins at said top surface of said space transformer and said ground conductor and said power conductor respectively is between 1 to 3 millimeters.
- [c6] 6. The space transformer of claim 1, wherein said decoupling capacitors have an inductance between 175 pico Henries and 1 nano Henry.
- [c7] 7. The space transformer of claim 1, wherein said decoupling capacitors have an inductance less than 60 pico Henries.
- [c8] 8. The space transformer of claim 1, wherein said ground conductor includes an outer region containing a channel for circulation of a coolant or a heating fluid.
- [c9] 9. The space transformer of claim 1, wherein said power conductor includes an outer region containing a channel for circulation of a coolant or a heating fluid.
- [c10] 10. A wafer test apparatus comprising:
a probe card;

a space transformer mounted to said probe card, said space transformer comprising:

a ground conductor;

a power conductor; and

one or more decoupling capacitors physically located between said ground conductor and said power conductor and electrically connected between a bottom surface of said ground conductor and a top surface of said power conductor; and

a probe mounted to said space transformer.

[c11] 11. The apparatus of claim 10, wherein said space transformer further includes:

one or more ground pins fixed to and extending from said ground conductor to a top surface of said space transformer;

one or more power pins fixed to and extending from said power conductor to said top surface of said space transformer; and

one or more signal wires extending from a bottom surface of said space transformer to said top surface of said space transformer.

[c12] 12. The apparatus of claim 11, further including:

an interposer mounted between said space transformer and said probe card, said interposer interconnecting said ground conductor, said power conductor and said one or more signal wires of said space transformer to said probe card.

[c13] 13. The apparatus of claim 11, wherein:

said ground conductor is located between said top surface of said space

transformer and said power conductor;
said power conductor is located between said ground conductor and said bottom surface of said space transformer;
said one or more power pins pass through said ground conductor without electrically contacting said ground conductor; and
said one or more signal wires pass through both said power and said ground conductors without electrically contacting either of said power or said ground conductors.

[c14] 14. The apparatus of claim 11, wherein the length of an electrical path between said decoupling capacitors and said one or more ground pins and said one or more power pins at said top surface of said space transformer is between 5 to 25 millimeters.

[c15] 15. The apparatus of claim 11, wherein the length of an electrical path between tips of said one or more ground pins and said one or more power pins at said top surface of said space transformer and said ground conductor and said power conductor respectively is between 1 to 3 millimeters.

[c16] 16. The apparatus of claim 10, wherein said decoupling capacitors have an inductance between 175 pico Henries and 1 nano Henry.

[c17] 17. The apparatus of claim 10, wherein said decoupling capacitors have an inductance less than 60 pico Henries.

[c18] 18. The apparatus of claim 10, wherein said ground conductor includes an outer region containing a channel for circulation of a coolant or a

heating fluid.

[c19] 19. The apparatus of claim 10, wherein said power conductor includes an outer region containing a channel for circulation of a coolant or a heating fluid.

[c20] 20. The apparatus of claim 10, wherein said probe is a thin film interface probe, a cantilevered probe or a spring-loaded probe.

[c21] 21. A space transformer comprising:
a ground conductor;
a power conductor;
one or more additional conductors;
one or more decoupling capacitors physically located between said ground conductor and said power conductor and electrically connected between said ground conductor said power conductor and between said ground conductor and said additional conductors;
one or more ground pins fixed to and extending from said ground conductor to a top surface of a product die mounted on a top surface of said ground conductor;
one or more power pins fixed to and extending from said power conductor to said top surface of said product die;
one or more additional pins fixed to and extending from said additional conductor to said top surface of said product die; and
one or more signal wires extending from a bottom surface of a board die mounted to a bottom surface of said power conductor to said top surface of said space transformer.

[c22] 22. The space transformer of claim 21, further including:
a inner die mounted to a bottom surface of an inner region of said power conductor; and
a capacitor board between a top surface of said power conductor and a bottom surface of said ground conductor, said decoupling capacitors mounted to said capacitor board.

[c23] 23. The space transformer of claim 22, wherein:
said ground conductor is located between said top surface of said space transformer and said power conductor;
said power conductor is located between said ground conductor and said one or more additional conductors;
said one or more additional conductors are located between said power conductor and said bottom surface of said space transformer;
said one or more ground pins pass through said product die;
said one or more power pins pass through said ground conductor without electrically contacting said ground conductor;
said one or more additional pins pass through said ground conductor and said power conductor and any intervening additional power conductors above each additional power conductor without electrically contacting any of said ground conductor, said power conductor and said intervening additional power conductors; and
said one or more signal wires pass through a board die, said inner die, said one or more additional conductors, said power conductor and said ground conductor without electrically contacting any of said power conductor, said ground conductor and said one or more additional

conductors.

- [c24] 24. The space transformer of claim 23, further including:
a cavity defined by a bottom surface of said inner die, a top surface of said board die and side walls of an interior region of said power conductor; and
wherein said signal wires pass through said cavity, the spacing of said signal wires decreasing from said board die to said inner die.
- [c25] 25. The space transformer of claim 21, wherein the length of an electrical path between said decoupling capacitors and said one or more ground pins and said one or more power pins at said top surface of said product die is between 5 to 25 millimeters.
- [c26] 26. The space transformer of claim 21, wherein the length of an electrical path between tips of said one or more ground pins and said one or more power pins at said top surface of said product die and said ground conductor and said power conductor respectively is between 1 to 3 millimeters.
- [c27] 27. The space transformer of claim 21, wherein said decoupling capacitors have an inductance between 175 pico Henries and 1 nano Henry.
- [c28] 28. The space transformer of claim 21, wherein said decoupling capacitors have an inductance less than 60 pico Henries.
- [c29] 29. The space transformer of claim 21, wherein said ground conductor includes an outer region containing a channel for circulation of a coolant

or a heating fluid.

[c30] 30. The space transformer of claim 21, wherein said power conductor includes an outer region containing a channel for circulation of a coolant or a heating fluid.